

Research Report

ICRR Inter-University Research Program 2020

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| Research Subject: Development of calibration and reconstruction system in KAGRA observation | |
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| Summary of Research Result: The joint observation of gravitational wave detectors in the world has provided the new view to study the fundamental physics. The gravitational wave is one of the important predictions of Einstein theory. The understanding of the gravitational wave physics has a potential for new discovery. The gravitational detectors of KAGRA, LIGO, Virgo and GEO600 were held on gravitational wave observation 3 (O3). KAGRA is one of the gravitational wave detectors in the worldwide observation. KAGRA employs two unique points. One is the cryogenic technology to reduce thermal noise. Another is the underground environment to reduce the seismic noise. KAGRA and GEO600 had a joint observation (O3GK) run between 2020 April.7 and 2020 April.21. In this run, our group have strongly contributed the calibration of interferometer and reconstruction of $h(t)$. The requirement of calibration uncertainty is 3% and 3 degree for future observing run. In this science program, To estimate the gravitational wave strain, $h(t)$, the calibration of KAGRA interferometer is essential process. In this program, we have developed photon calibrator as a main calibrator of KAGRA. We installed this system on 2019 and have kept characterizing until O3GK. Photon calibrator can give a displacement by pushing with photon pressure. During O3GK, we injected the calibration line to the interferometer to monitor the gain drift. We also used photon calibrator for weekly calibration measurement. By using data set of weekly calibration measurement, we estimate the parameters of interferometer based on the model of instruments. We fit the data simultaneously and estimated the expected errors. Finally, we reconstructed the gravitational wave strain for two weeks data set. The reconstructed data was applied to event search pipeline with GEO600 data. First result of gravitational wave observation of O3GK will be published soon. We have developed and characterized the gravity field calibrator in NCU. Gravity field calibrator is a new instrument to achieve the sub present accuracy. By rotating the masses, gravity field calibrator can generate the gravity gradient around the end test mass. By using this method, we can calibrate the displacement of the interferometer. In last summer, we shipped 4 calibrators to KAGRA observatory. This system will be used future observation run. Unfortunately, we need to consider the delay of project schedule because of COVID-19. We are discussing the schedule of next observation. | |
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